BABCOCK INSTITUTE DISCUSSION PAPER
No. 2001-2

CHARACTERISTICS OF FOOD EXPENDITURES IN ARGENTINA: IMPLICATIONS FOR THE U.S. DAIRY INDUSTRY

Ricardo Sabates
Brian W. Gould

The Babcock Institute for International Dairy Research and Development
University of Wisconsin, College of Agricultural and Life Sciences
240 Agriculture Hall, 1450 Linden Drive
Madison, Wisconsin 53706-1562

The Babcock Institute for International Dairy Research and Development
is a joint program of the
University of Wisconsin-Madison College of Agricultural and Life Sciences
University of Wisconsin-Madison School of Veterinary Medicine
University of Wisconsin Extension Cooperative Extension Division

Funding for this study was provided by CSRS USDA Special Grant 95-34266-2211

The Babcock Institute
College of Agricultural and Life Sciences
240 Agriculture Hall, 1450 Linden Drive
Madison, Wisconsin 53706

Phone: 608-265-4169; Fax: 608-262-8852
Email: babcock@calshp.cals.wisc.edu
URL: http://babcock.cals.wisc.edu

Table of Contents

Tables and Figures

CHARACTERISTICS OF FOOD EXPENDITURES IN ARGENTINA: IMPLICATIONS FOR THE U.S. DAIRY INDUSTRY

Ricardo Sabates[*] and Brian W. Gould[**]

Introduction

Dairy products compete with other types of food for the consumer's limited budget. This is true for the United States as well as other countries. With the increasing emphasis on expanding the export market for the U.S. dairy products, it is important to understand the overall structure of food demand in these potential markets. This publication represents the third in a series of studies that have attempted to provide information that can assist policymakers, potential exporters and other dairy industry participants in identifying the determinants of dairy and non-dairy product food choices in a number of international settings. In previous discussion papers we have examined household food expenditures in Mexico, Canada and the Former Soviet Union (Gould and Kim, 1998; Kim and Gould, 1998). These countries were chosen for analysis because of their current importance as destinations for our dairy product exports. In this publication, we provide an overview of food demand characteristics in Argentina where U.S. dairy product exports are limited.[1] Argentina is one of the major countries in South America and understanding the role of dairy products in Argentine diet can provide useful information for the potential expansion of U.S. dairy exports into non-traditional markets such as South America. As in previous analyses, household-level food expenditure data are used.

In this discussion paper, we present the results of a series of econometric analyses of dairy and non-dairy food expenditures—specifically, the impact of household income and other household characteristics on Argentine household food purchase decisions. In the remainder of this report, we present an overview of the data used, some general dairy and non-dairy food purchase characteristics of Argentine households, a description of the econometric model used to quantify the important determinants of such purchases, and a review of the econometric results.

I. Data Used in the Food Expenditure Analysis

This paper will provide an analysis of the structure of Argentine dairy and non-dairy food expenditures. This structure will be analyzed via the use of a series of econometric models. The analysis is based on a household survey of more than 27,000 Argentine households (1996-1997 *Encuesta Nacional de Gasto de los Hogares* [1996/97 ENGH]). These data originate from a national household expenditure survey of randomly selected households in the major urban areas of Argentina undertaken by the National Institute of Statistics and Census. Data were collected over a 13-month period, from February 1996 through March 1997. The use of household-level

[*] Ricardo Sabates is a Research Assistant in the Development Studies Program, Department of Agricultural and Applied Economics, University of Wisconsin-Madison.

[**] Brian W. Gould is a Senior Scientist in the Wisconsin Center for Dairy Research, Department of Agricultural and Applied Economics, University of Wisconsin-Madison.

[1] For example, over the 1996-1999 period, Argentina imported an average of 1,312 metric tons of U.S. produced cheese annually. This figure represents an average of 3.6% of total U.S. cheese exports.

data allows us to investigate the role of household income, household composition, and other factors that determine the decision to purchase a commodity in the first place, and if so, in what amounts—that is, the two-step purchase process, whether-or-not to buy and the amount to buy.

Surveyed households were asked to maintain a weekly diary of household expenditures for durable and non-durable commodities, including a detailed set of food commodities. In addition to expenditure data, information concerning household and member characteristics were also collected. Examples of member-specific characteristics include age, education, occupation, marital status, and gender. Household-specific data include household size, physical characteristics of the shelter, and access to water and sanitation. A total of 27,260 household responses were used in the estimation of the various econometric models discussed below.

II. Characteristics of Argentine Food Expenditures

Table 1 provides an overview of weekly food expenditures. The first column identifies the commodity groups used in our econometric analysis (defined by Table A.3). The second column shows the percentage of households purchasing a particular food category over the one-week survey period. The last two columns provide mean unconditional (includes zero expenditures) and conditional (only non-zero values) food expenditures, respectively.

Compared to other foods, dairy products have a relatively high frequency of purchase, although mean conditional expenditure values are relatively low at 4.1 pesos and 5.5 pesos per week for "Milk" and "Other Dairy," respectively. "Beef" is one of the most important food products in Argentina. More than 87% of the households reported "Beef" expenditures, which is

Table 1. Weekly Argentine Food Expenditure Characteristics*

Commodity	% Purchasing	Unconditional Expenditure	Conditional Expenditure
		Pesos	
Milk	72.5	3.0	4.1
Other Dairy	69.0	3.8	5.5
Flour	52.4	1.3	2.5
Pastas	62.2	2.4	3.8
Beef	87.3	10.3	11.8
Poultry	49.4	3.3	6.6
Fish / Shellfish	16.9	0.8	4.6
Other Meats	58.3	2.9	5.0
Fruits	76.0	3.7	4.9
Vegetables	90.8	5.2	5.7
Alcoholic Beverages	39.2	2.3	5.8
Non-Alc. Beverages	85.0	6.2	7.3
MAFH	27.6	7.3	26.2

*Source: 1996/97 ENGH. Note: These values are calculated using weighted data to be representative of the Argentine population. These weights were supplied by ENGH. Conditional expenditures are mean purchases excluding non-purchasing households. Refer to Appendix A for a detailed description of the commodity groupings listed above. MAFH represents Meals Away From Home.

much higher than the 49% of households that reported "Poultry" purchases. Slightly more than 58% of surveyed households purchase "Other Meats" which includes pork, lamb, rabbit, hare, boar, and ofals. With the exception of "Meals Away From Home" (MAFH), on average, Argentine households spend considerably more on "Beef" than on any other food commodity listed in Table 1. The mean unconditional weekly "Beef" expenditure is 10.3 pesos, compared to a conditional mean "Beef" expenditure of 11.8 pesos. "MAFH" expenditures averaged 7.3 pesos per week across all households, and 26.2 pesos per week for purchasing households.

The 1996/97 ENGH survey does not contain information on quantity purchased thus we are limited to an analysis of expenditures.[2] Specifically, in the econometric models described below, we estimate a series of Engel curves that show the relationship between food expenditures and household income.[3] As an introduction, Table 2 provides an initial representation of the relationship between income and expenditures on dairy and non-dairy foods obtained from Instituto Nacional de Estadística y Censos (1998). This table clearly shows a positive relationship between income and food expenditures, and a negative relationship between household income and the share of income associated with food. Households in the lowest income decile spend more than 65% of total income on food. This compares with less than 17% for households in the highest decile.[4]

Not only are there significant relationships between income and the percentage of income associated with food purchases; there are some dramatic differences in the allocation of food expenditures across food groups. For the lowest income decile households, meat purchases account for 22.5% of total food expenditures, compared to 9.7% for the highest income decile population. This is in stark contrast to the pattern observed for dairy products. Except for the lowest and the highest income decile households, total dairy product expenditures remain constant for all income groups and account for approximately 10.5% of total food expenditures. For other products, like "MAFH" and "Fish/Shellfish," there is a positive relationship between income and food expenditures. The highest income decile spends more than 26.0% of total food expenditures on "MAFH," while the lowest income decile just spends 2.7%. For other food categories, like "Poultry" and "Fruit," the percentage of total food expenditures associated with these commodities increases for the first three or four lowest income deciles and declines thereafter.

Whereas Table 2 shows the distribution of food expenditures across commodity groups, Table 3 shows the relationship between income level, percentage of purchasing households, and expenditure levels for purchasing households. In general, there is a positive relationship between purchase probability and household income across food groups, however there are some differences across specific foods. Slightly less than 53% of the households from the lowest

[2] We are currently attempting to obtain more detailed dairy product data, which would include a more disaggregated dairy product grouping and would also include both prices paid and quantities purchased.

[3] Household income includes not only wage income over the past six months but also income from transfers, rents, other capital assets, and the implicit value of in-kind.

[4] For the population as a whole, 34% of total expenditures is allocated to food purchases.

Table 2. Food Expenditure Characteristics of Argentine Households by Income Deciles*

Decile	Average Monthly Income (Pesos)	Monthly Food Expend. (Pesos)	Food Exp. % of Total Income	Percent of Total Food Expenditure (%)											
				Milk	Other Dairy	Poultry	Fish/ Shell-fish	Beef/ Pork / Lamb	Flour/ Pastas	Fruit	Veg.	Alcoh. Bev.	Non-Alcoh. Bev.	MAFH	Other Food
1	281.8	184.3	65.4	6.0	3.3	3.3	0.7	22.5	8.0	3.9	9.7	2.5	4.8	2.7	32.9
2	466.4	227.6	48.8	6.1	4.3	4.5	0.8	21.4	6.5	4.7	9.0	2.9	5.7	3.7	30.4
3	565.4	234.4	41.5	5.5	4.8	5.1	0.9	20.5	6.2	5.1	8.9	3.2	6.1	4.7	29.0
4	678.2	259.7	38.3	5.4	5.2	5.3	1.0	19.7	5.7	5.6	8.4	3.2	6.6	5.7	28.3
5	768.6	260.4	33.9	5.1	5.5	5.4	1.2	18.7	5.5	5.9	8.2	3.0	7.1	6.2	28.3
6	897.5	278.1	31.0	4.7	5.9	5.7	1.2	17.1	5.7	5.8	7.9	3.1	6.9	8.1	27.9
7	1,104.7	313.6	28.4	4.3	6.3	5.5	1.4	16.0	5.2	6.0	7.8	3.1	7.3	9.5	27.7
8	1,254.0	333.1	26.6	3.8	6.8	5.0	1.2	14.5	5.3	6.1	7.5	3.5	7.3	11.2	28.0
9	1,644.1	369.2	22.5	3.3	6.4	4.9	1.5	13.4	4.7	6.1	6.8	4.1	7.3	14.6	27.0
10	2,879.9	479.3	16.6	2.5	6.0	3.6	1.3	9.7	3.6	5.1	5.5	4.2	6.5	26.3	29.3

*Source: Instituto Nacional de Estadística y Censos, (1998). Weekly food expenditure transformed to monthly basis by multiplying by a 4.3 factor. MAFH represents meals away from home.

income decile purchase "Milk," compared with nearly 80% from the highest decile.[5] The purchase of "Other Dairy" follows a similar pattern, with the purchasing percentage increasing from 39.0% for the lowest decile to 84.8% for the highest. The mean conditional "Milk" expenditures increased from 2.8 pesos to 5.3 pesos from the lowest to highest decile respectively. For "Other Dairy," the expenditures range from 2.6 pesos to 9.8 pesos per week for these two decile groups.

In contrast to dairy products, there is a high frequency of "Beef" purchases across income level. The minimum purchase frequency of 80.8% was obtained for the lowest income decile households. Although the frequency of "Beef" purchases remains relatively constant, the amount purchased is positively related to income. Conditional weekly expenditures increase from 6.3 pesos for the lowest decile to 17.8 pesos for the highest. Expenditure patterns for "Pastas," "Poultry," "Fish," "Other Meats," and "Fruits" follow a similar pattern. The percentage of households purchasing "MAFH[6]" increases rapidly with income. For households in the lowest income decile, only five percent of households surveyed purchase "MAFH" compared to more than 50% for the highest decile households. For purchasing households, there is a dramatic increase in weekly expenditures especially for the highest three deciles. The conditional weekly mean "MAFH" expenditures increase from 14.0 to 45.2 from the lowest to the highest income decile households.

III. Description of Variables Used in the Econometric Models of Dairy and Non-Dairy Food Expenditures

As noted in the introduction, we use the 1996/97 ENGH survey to examine the structure of the demand for specific food types via a series of econometric models. The dependent variable in each of these models is the monthly expenditure on specific commodities.[7] The explanatory variables will consist of a set of household characteristics. Table 4 provides a listing of these exogenous variables.

As previously stated, the 1996/97 ENGH surveyed urban households in six separate regions. Table 4 provides a listing of the regions delineated in our data sets and associated subregions. Table 5 shows the average income from each region as well as the distribution of total food expenditures among food commodities (National Institute of Statistics and Census, 1998). There is little variation in the percentage of total income devoted to food purchases across regions, but there does appear to be some differences in allocation. Surveyed households in the *Metropolitana* region spent over 17% of total food expenditure on MAFH.

Table 6 provides a more detailed analysis of weekly food purchase characteristics for households in the six regions. For each food category, the shaded cells indicate the maximum and minimum values of purchase frequency and conditional expenditures. Percentage of households purchasing dairy products during the week ranges from 56.8% to 76.5%. Conditional

[5] Gould and Kim (1998) found that 20% of households from the lowest income decile in Mexico purchased milk in 1994 compared to 80% of the households from the highest income decile.

[6] Meals Away From Home.

[7] Following, Instituto Nacional de Estadística y Censos (1998) weekly expenditures are converted to monthly expenditures by multiplying by a constant factor of 4.3.

Table 3. Characteristics of Argentine Weekly Food Expenditures by Income Decile*

Decile	Milk		Other Dairy		Beef		Poultry		Fish		Other Meats		Flour	
	% of HH	Cond. Expend. (Pesos)	% of HH	Cond. Expend. (Pesos)	% of HH	Cond. Expend. (Pesos)	% of HH	Cond. Expend. (Pesos)	% of HH	Cond. Expend. (Pesos)	% of HH	Cond. Expend. (Pesos)	% of HH	Cond. Expend. (Pesos)
1	53.5	2.8	39.0	2.6	80.8	6.3	48.8	2.0	8.7	3.1	35.1	2.7	48.8	2.0
2	64.7	3.2	52.3	3.2	86.2	7.7	53.9	2.1	12.0	3.2	44.5	3.2	53.9	2.1
3	69.0	3.4	60.8	3.4	88.8	9.1	52.9	2.1	10.9	3.6	47.8	3.5	52.9	2.1
4	72.7	3.7	65.6	3.9	89.6	10.0	56.0	2.3	15.4	3.8	53.5	3.7	56.0	2.3
5	73.5	4.0	69.8	4.2	89.1	11.0	54.0	2.3	14.7	4.0	60.2	4.1	54.0	2.3
6	75.3	4.2	72.8	4.8	89.5	12.2	57.1	2.4	16.1	4.0	60.0	4.6	57.1	2.4
7	75.3	4.4	76.1	5.2	88.3	13.0	52.9	2.4	18.2	4.5	64.1	4.8	52.9	2.4
8	78.7	4.4	78.7	6.4	88.8	13.8	52.7	2.6	19.5	4.9	68.3	5.4	52.7	2.6
9	79.2	4.7	81.9	7.2	87.2	15.1	49.0	2.9	23.7	5.2	72.3	6.3	49.0	2.9
10	79.2	5.3	84.8	9.8	84.1	17.9	48.3	3.4	26.7	6.3	70.7	8.1	48.3	3.4

(continued)

Table 3. Characteristics of Argentine Weekly Food Expenditures by Income Decile (Continued)*

Decile	Pastas		Fruit		Vegetables		Alcoh. Bev.		Non-Alcoho. Bev,		MeAFH	
	% of HH	Cond. Expend. (Pesos)	% of HH	Cond. Expend. (Pesos)	% of HH	Cond. Expend. (Pesos)	% of HH	Cond. Expend. (Pesos)	% of HH	Cond. Expend. (Pesos)	% of HH	Cond. Expend. (Pesos)
1	47.8	2.1	52.4	2.6	82.8	3.3	19.4	3.5	68.9	3.2	5.2	14.0
2	58.2	2.4	66.0	3.1	89.0	4.1	27.3	3.9	78.4	3.8	9.2	13.2
3	60.0	2.8	71.1	3.4	90.9	4.4	31.1	4.0	81.6	4.6	12.3	13.3
4	60.8	2.9	73.7	3.8	92.3	4.9	35.6	4.2	84.0	5.3	16.1	15.4
5	64.9	3.2	78.5	4.0	92.4	5.2	38.8	4.4	85.7	6.0	22.9	16.5
6	64.0	3.6	77.9	4.5	92.2	5.7	40.5	4.9	89.4	6.6	26.6	17.7
7	63.7	4.0	81.9	5.1	92.9	6.1	45.2	5.5	88.1	7.5	31.9	19.6
8	67.1	4.4	82.6	5.6	92.2	6.4	46.4	6.3	89.8	8.9	36.7	23.3
9	66.5	4.9	85.0	6.2	91.3	7.4	50.3	6.5	89.8	10.4	47.1	27.3
10	65.7	6.1	85.6	8.0	91.1	8.8	51.5	9.8	90.9	13.1	59.0	45.2

*Source: Instituto Nacional de Estadística y Censos, (1998).

Note: The values for conditional expenditures are calculated using weighted data. Conditional expenditures are mean purchases excluding non-purchasing households. The value for unconditional expenditure is obtained by multiplying the conditional expenditure times percentage of households that purchase the product. Refer to Table 2 for mean income levels for each decile.

Table 4. Exogenous Variables Used in the Econometric Models

Variable	Description	Units	Mean
Household Characteristics			
TOT_INC	Monthly Income	Pesos	1007.7 (865.0)
HH_SIZE	Household Size	#	3.60 (1.99)
FT_RATIO	Ratio of Adults Working to Total Adults in the Household	#	0.491 (0.3492)
Meal Planner's Education - Dummy Variables			
ELEM_ED	Elementary Education	0/1	0.6500
HISC_ED	High School Education	0/1	0.2310
COLL_ED	College Education	0/1	0.0966
NO_ED	No-education	0/1	0.0222
Meal Planner's Life-cycle - Dummy Variables			
Y_NK	Young Without Children	0/1	0.0669
YM_1ADWK	Young and Middle-Aged One Adult With Children	0/1	0.0290
Y_MADWK	Young Multiple Adults Without Children	0/1	0.1777
MA_1ADNK	Middle-Aged One Adult Without Children	0/1	0.0513
MA_MADNK	Middle-Aged Multiple Adults Without Children	0/1	0.2079
MA_MADWK	Middle-Aged Multiple Adults With Children	0/1	0.2860
S_NK	Senior Without Children	0/1	0.1578
S_WK	Senior With Children	0/1	0.0235
Regional Dummy Variables			
MA_1	Federal District Buenos Aires (***Metropolitana)***	0/1	0.1236
MA_2	Suburban Area Buenos Aires (***Metropolitana***)	0/1	0.2950
PAM_1	Córdoba and La Pampa (***Pampeana***)	0/1	0.0888
PAM_2	Santa Fe and Entre Ríos ***(Pampeana***)	0/1	0.1141
PAM_3	Buenos Aires (***Pampeana***)	0/1	0.1378
NO_1	Jujuy, Salta and Tucumán (***Noroeste***)	0/1	0.0578
NO_2	La Rioja, Catamarca and Santiago del Estero (***Noroeste***)	0/1	0.0224
NE_1	Misiones and Corrientes (***Noreste***)	0/1	0.0351
NE_2	Chaco and Formosa (***Noreste***)	0/1	0.0258
CUYO	San Juan, Mendoza and San Luis (***Cuyo***)	0/1	0.0574
PAT_1	Neuquén and Río Negro (***Patagonia***)	0/1	0.0237
PAT_2	Chubut, Santa Cruz and Tierra del Fuego (***Patagonia***)	0/1	0.0185

Note: The total sample size was 27,066 households. Standard errors are in parenthesis.

Table 5. Food Expenditure Characteristics of Argentine Households by Region*

Region	Monthly Income (Pesos)	Monthly Food Expend. (Pesos)	Food Exp. % of Total Income	Percent of Total Food Expenditure (%)											
				Milk	Other Dairy	Poultry	Fish, Shell-fish	Beef, Pork, Lamb	Flour/ Pastas	Fruit	Veg.	Alcoh. Bev.	Non-Alcoh. Bev.	MAFH	Other Food
Metropo-litana	1,202.7	331.4	27.6	3.8	5.9	4.8	1.3	13.5	4.9	5.3	7.2	3.2	7.2	17.1	26.0
Pampeana	950.4	259.8	27.3	4.9	5.8	4.9	1.1	18.0	5.7	6.0	7.9	3.9	5.8	6.0	30.0
Noroeste	884.0	281.7	31.9	4.2	4.5	4.5	1.1	21.5	5.2	5.2	8.7	2.5	8.1	5.4	29.2
Noreste	822.3	248.1	30.2	6.1	4.4	4.5	0.5	20.3	6.8	4.8	8.5	3.8	6.5	4.2	29.6
Cuyo	950.2	250.4	26.4	4.6	5.6	5.3	1.5	19.1	5.3	5.6	8.5	3.0	5.8	5.5	30.1
Patagonia	1,192.8	293.1	24.6	4.4	5.8	5.1	1.0	18.8	6.6	5.1	8.1	3.4	6.1	5.0	30.7

*Source: Instituto Nacional de Estadística y Censos, (1998).
Note: Weekly food expenditure converted to a monthly basis by multiplying by a 4.3 factor.
Cities included in each region:
Metropolitana (ME): Federal District Buenos Aires and its Suburban areas.
Pampeana (PAM): Córdoba, La Pampa, Entre Ríos, Santa Fe, and Rest of Buenos Aires.
Noroeste (NO): Jujuy, Salta, Tucumán, Catamarca, La Rioja, and Santiago de Estero.
Noreste (NE): Corrientes, Misiones, Chaco, and Formosa.
Cuyo: Mendoza, San Juan, and San Luis.
Patagonia (PAT): Neuquén, Río Negro, Chubut, Santa Cruz and Tierra del Fuego.
The shaded cells indicate minimum and maximum percentage allocation of food expenditures across specific food groups.

Table 6. Characteristics of Argentine Weekly Food Expenditures by Region*

Region	Milk		Other Dairy		Beef		Poultry		Fish		Other Meats		Flour	
	% of HH	Cond. Expend. (Pesos)	% of HH	Cond. Expend. (Pesos)	% of HH	Cond. Expend. (Pesos)	% of HH	Cond. Expend. (Pesos)	% of HH	Cond. Expend. (Pesos)	% of HH	Cond. Expend. (Pesos)	% of HH	Cond. Expend. (Pesos)
ME	76.5	3.9	72.7	6.1	84.1	11.4	48.9	2.3	21.1	4.6	58.6	5.1	48.9	2.3
PAM	75.7	4.0	69.5	5.1	89.3	11.6	52.3	2.3	15.4	4.3	59.7	4.7	52.3	2.3
NO	58.0	4.7	61.9	4.7	91.6	14.3	64.7	2.5	11.0	4.8	53.7	4.8	64.7	2.5
NE	69.1	5.1	54.6	4.7	91.0	12.0	65.7	3.1	5.2	5.4	51.1	4.3	65.7	3.1
CUYO	60.0	4.4	69.1	4.7	90.7	11.6	50.2	2.2	20.3	4.2	59.1	4.4	50.2	2.2
PAT	56.8	5.2	61.6	6.2	81.7	13.2	48.5	4.4	12.0	5.6	61.9	7.5	48.5	4.4
	Pastas		Fruit		Vegetables		Alcoho. Bev.		Non-Alcoho. Bev.		MAFH			
	% of HH	Cond. Expend. (Pesos)	% of HH	Cond. Expend. (Pesos)	% of HH	Cond. Expend. (Pesos)	% of HH	Cond. Expend. (Pesos)	% of HH	Cond. Expend. (Pesos)	% of HH	Cond. Expend. (Pesos)		
ME	62.9	4.1	76.8	5.3	90.2	6.1	37.3	6.3	87.0	8.3	43.6	29.0		
PAM	62.9	3.7	78.7	4.7	91.1	5.3	42.7	5.7	83.6	6.3	17.4	20.6		
NO	59.8	2.9	75.7	4.5	91.8	6.2	34.6	4.6	88.0	7.5	18.0	19.0		
NE	63.4	3.0	60.8	4.6	92.0	5.3	38.5	5.6	85.4	6.3	12.4	18.9		
CUYO	62.0	3.2	75.6	4.3	94.4	5.3	38.7	4.5	79.1	6.1	14.9	21.0		
PAT	51.1	4.5	69.4	5.0	85.5	6.3	39.6	5.7	79.3	7.4	9.3	33.2		

*Source: Computed by the authors from the 1996/97 ENGH.

Note: The values for conditional expenditures are calculated using weighted data. Conditional expenditures are mean purchases excluding non-purchasing households. The value for unconditional expenditures is obtained by multiplying the conditional expenditure times percentage of households that purchase the product. Refer to Table 4 for mean income levels for each region. The shaded cells indicate minimum and maximum percentages allocation of food expenditures across specific food groups.

expenditures range from 3.9 to 5.2 pesos per week. The lower amount is for the region with the highest purchasing frequency and the higher amount is for the region with the lowest purchasing frequency.

Besides household income (TOT_INC) and location, other household characteristics are also hypothesized to impact food expenditures. As noted above, the dependent variables in the various econometric models is **total** household food expenditures. With this definition, one would expect that larger households would have larger expenditures. Thus, we would expect household size (HH_SIZE) to be an important control variable in the analysis of food expenditure, and to have a positive impact on such expenditures.

It hypothesized that household size impacts food expenditures and that the composition of this household would also have an impact on food choice. Using the 1996/97 ENGH, we find slightly more than 21% of total households are characterized as being composed of extended families—55.5% are families with children (either single parents or couples), slightly over 11% are families without children, and over 11% are single-person households.

There are a number of methods that can be used to analyze the impact of household composition on food expenditures. For this analysis, we define a series of binary household life-cycle variables. These binary variables are used to identify how food purchase patterns differ across households as the family unit expands or contracts over its "lifetime."[8]

The household life-cycle variables used here are based on three elements of household composition. The first element used in the derivation of the life-cycle variables is the age of the **meal planner**.[9] The following age group definitions were used to categorize the age of the meal planner: young (under 35 years old), middle-aged (35-64 years old), and senior (over 55 years old). The second element is the number of adults living in the household—one adult versus multiple-adults. The third element is whether or not children under the age of 16 are living in the household. Using these three elements, we define the following eight household life-cycle stages: *Young Without Children* (Y_NK), *Young and Middle-Aged One Adult With Children* (YM_1ADWK), *Young Multiple Adults With Children* (Y_MADWK), *Middle-Aged One Adult Without Children* (MA_1ADNK), *Middle-Aged Multiple Adults Without Children* (MA_MADNK), *Middle-Aged Multiple Adults With Children* (MA_MADWK), *Seniors Without Children* (S_NK), and *Seniors With Children* (S_WK).[10]

[8] Examples of the use of similar life-cycle variables in the analysis of food demand can be found in Wells and Gubar (1966), Murphy and Staples (1979), and Haung and Raunikar (1993).

[9] Identifying the meal planner for single adult households was not difficult. With multiple adults present, we need to make some assumptions as to who was the household meal planner. If both parents live in the household, the meal planner will be the female. In the case of extended families, the meal planner will be the self-enumerated head of the household. With this classification, in our sample we have determined that 20% of the meal planners are males and 80% are females.

[10] In some of the categories we do not distinguish between one adult and multiple adults, i.e., in Young Without Children. Two parameters are taken into account when merging categories. The first is the low percentage of households that fall into one of these categories. Second, we note that when children are living in the shelter they have a greater impact on household food expenditures. As an example, only 2.4% of the sample households are Young One Adult Without Children and 4.2% are Young Multiple Adults Without Children. Therefore, we decided to merge these two categories into one,

Labor force participation of adult family members is hypothesized to impact food expenditures due to the substitution of family member labor away from the preparation of food and the purchase of more processed foods. That is, with more household adult members participating in the labor market, there is less time available for the preparation of family meals. As a result, there may be a tendency for the household to purchase more expensive types of food that incorporate additional amounts of food processing to reduce the amount of time required for preparing home-consumed meals. For this analysis, we use the ratio of the number of adult members working outside the home to the total number of adults living in the household (FT_RATIO) as a measure of labor force participation of family adult members.[11] In the analysis of food expenditure for U.S. families, the number of adult members working outside the home is considered an important determinant of food expenditure patterns. For the Argentine situation, however, with the abundance of housekeeping services available we are unsure how important labor force participation is to the choice of foods purchased.

In previous analyses of dairy and non-dairy food purchases in the U.S. and Canada, educational status has been included as an explanatory variable (Gould and Lin, 1994; Gould and Kim, 1998). The rationale for including this variable is that more educated, higher income households tend to be more concerned with the health implications of food choices. If there is a positive relationship between nutritional concerns and educational attainment of the meal planner, then more educated households may differ in their purchase patterns given the nutritional characteristics of many types of dairy products. For this analysis, we included four dichotomous education variables. The first variable is ELEM_ED, where the meal planner has some formal education but had not completed junior high school. The second variable is HISC_ED, where the meal planner has at a minimum completed junior high school, but had at most completed high school. The third education variable is COLL_ED, where the meal planner attended college at some level. The fourth education variable is NO_ED, where the meal planner has no formal education (2.21% of meal planners). All the variables are set to one when true and set to zero otherwise.

IV. Econometric Models of Argentine Food Expenditures

The traditional Engel curve analysis forms the theoretical basis of our econometric models to examine the relationship between expenditures and income and is represented by the following equation:

$$(1) \quad E_i = f\left(Y \mid D\right)$$

where E_i is the total expenditure on food category i, Y stands for household income and D is a set of other household characteristics.

Young Without Children. A similar procedure was applied to both "Seniors" categories, e.g., S_NK and S_WK. Finally, the variable Young One Adult With Children was merged with Middle-Aged One Adult With Children.

[11] We were limited to this variable, given that no information was available concerning the extent of labor force participation (e.g., hours worked out of the home).

As shown in Table 3, there are significant numbers of households that did not purchase a particular commodity during the surveyed week. Therefore, the use of traditional regression procedures, such as ordinary least squares to estimate the Engel curve in equation 1, could result in inconsistent parameter estimates (Maddala, 1983). To overcome this problem, we utilize a variant of the traditional regression model of food expenditures, which accounts for the presence of a significant percentage of non-purchasing households. This alternative econometric model incorporates the relationship between unconditional purchases Y, and a stochastic index Y*, which is observed only when expenditures are positive. The relationship between Y and Y* can be represented by the following equation:

$$(2) \quad Y = \begin{cases} Y^* \ if \ Y^* > 0 \\ 0, \text{ otherwise} \end{cases}$$

This model is commonly referred to as the Tobit model. Under this specification, latent consumption Y^*, is related to household characteristics (X) by the following equation:

$$(3) \quad Y^* = X\beta + e$$

where β is a vector of regression coefficients, e is a vector of error terms, $e_j \sim N(0,\sigma^2)$, j = 1,…,T, and T is the total number of households in the sample.

The formulation represented in equation 3 is assumes that the error term is homoscedastic. In other words, the error term variance does not vary across household and there is no correlation of error terms across households. Given that the dependent variable is defined as expenditure on specific/total commodities and our use of household survey data, there is a possibility that heteroscedasticity could be present. That is, $e_j \sim N(0,\sigma_j^2)$, where the j^{th} observation's variance is related to a separate set of exogenous variables. The presence of heteroscedasticity in the error term structure of the Tobit model will be tested for all food expenditure categories using a likelihood ratio test. Testing for heteroscedasticity is important as under the Tobit specification, and in contrast to the traditional regression results, heteroscedasticity can result in inconsistent parameter estimates (Greene, 1993). A detailed description of the heteroscedastic Tobit model is presented in Appendix B.

We apply the above Tobit model to analyze Argentine household food expenditures using the microdata available from the 1996/97 ENGH survey. McDonald and Moffit (1980) show how one can decompose the effect of a change in an exogenous variable on both the probability of purchasing a particular food commodity as well as the level of expenditures if the household does in fact purchase the product (e.g., conditional expenditures). That is:

$$(4) \quad \frac{\partial E(Y)}{\partial X} = \frac{\partial \Pr(Y>0)}{\partial X} E(Y \mid Y>0) + \Pr(Y>0) \frac{\partial E(Y \mid Y>0)}{\partial X}$$

Using equation 4 as a basis, the authors also show how to evaluate these impacts in terms of elasticity measures. For the present analysis, we will estimate the elasticity impacts on dairy and non-dairy food expenditures for change in household income. That is, we will decompose the total income effects into the conditional income elasticity response and the change in the

probability of purchasing a particular food product. A detailed description of the decomposition used in this paper is also presented in Appendix B.

V. Application of the Econometric Model to an Analysis of Argentine Food Expenditures

We apply the Tobit structure outlined in Appendix B to the analysis of 13 categories of dairy and non-dairy food expenditures identified in Table A.3. First we estimate parameters for both homoscedastic and heteroscedastic versions of the Tobit model. After estimating these two model specifications, we undertake a likelihood ratio test for the presence of heteroscedasticity for each of the food categories. Under the heteroscedastic specification we assume that the error variance is related to the variables household income (TOT_INC) and household size (HH_SIZE) using an exponential functional form (equation B.7). For all food categories, the results of the likelihood ratio tests indicate a rejection of the null hypothesis of a homoscedastic error structure. Given the results of these tests, the heteroscedastic Tobit model results will be presented for the remainder of this analysis.

Table 7 shows the heteroscedastic Tobit parameter estimates obtained from implementing the likelihood function represented in equation B.6. The shaded cells of this table identify estimated parameters that are statistically significant at the 95% level. The last three rows of this table show the parameter estimates associated with the variables in the heteroscedastic function (equation B.7).

Greene (1993) shows that under the homoscedastic Tobit specification, the sign of the marginal impact of a change in an exogenous variable on quantity purchased and probability of purchases is the same as the sign of the associated coefficient. When the exogenous variables in the heteroscedastic Tobit model do not affect the variance of the error structure, the result stated by Greene (1993) would still hold. Alternatively, when an exogenous variable also impacts error term variance (e.g., income), the marginal effect of a change in the exogenous variable has two components (see equations B.12 and B.13). The first term is identical to the one obtained for the homoscedastic case and the second term is the additional change-induced income in the variance of the error structure. For the present analysis we estimate the marginal impact of changes in household income using these two equations.

Summary of Dairy Product Results

Table 7 shows that a majority of the estimated coefficients are statistically significant in the Tobit equations for "Milk" and "Other Dairy." The significant negative FT_RATIO[12] coefficients may reflect reduced at-home food expenditures. These results may also be due to the incorporation of the "children effect" in this variable, as it is hypothesized that households with fewer children have greater labor force participation of adult household members.

We also included educational status of the meal planner to analyze whether there are some purchasing differences in food categories for more educated households. The education impacts on dairy product purchases are in contrast to our initial hypothesis that there would be increased

[12] The ratio of the number of adult members working outside the home to the total number of adults living in the household.

nutritional concerns associated with dairy product consumption for more educated households, which would translate to reduced consumption rates. In Table 7 we see that in households whose

Table 7. Tobit Parameter Estimates for Various Food Groups*

Variable	Milk	Other Dairy	Beef	Poultry	Fish	Other Meats	Flour	Pastas	Fruit	Veggies	Alcoh. Drinks	No-Alcoh Drinks	Meals Away
INTERCEPT	0.094 (0.007)	0.051 (0.009)	0.383 (0.014)	-0.014 (0.013)	-0.352 (0.021)	-0.004 (0.012)	0.036 (0.008)	0.094 (0.007)	0.068 (0.007)	0.259 (0.007)	-0.135 (0.015)	0.157 (0.009)	-1.304 (0.084)
Household Characteristics													
INCOME	0.438 (0.021)	1.164 (0.031)	1.654 (0.050)	0.830 (0.037)	0.365 (0.068)	0.826 (0.040)	-0.066 (0.024)	0.324 (0.025)	0.960 (0.025)	0.715 (0.026)	0.692 (0.054)	1.595 (0.037)	4.975 (0.272)
1/HHSIZE	-0.046 (0.008)	-0.029 (0.010)	-0.373 (0.015)	-0.055 (0.016)	0.026 (0.026)	-0.099 (0.013)	-0.101 (0.008)	-0.105 (0.008)	-0.028 (0.008)	-0.181 (0.008)	-0.215 (0.021)	-0.076 (0.010)	0.018 (0.123)
FT_RATIO	-0.026 (0.004)	-0.016 (0.005)	-0.008 (0.007)	-0.031 (0.007)	-0.049 (0.011)	-0.005 (0.006)	-0.013 (0.004)	-0.009 (0.004)	-0.026 (0.004)	-0.026 (0.004)	0.037 (0.008)	0.001 (0.005)	0.726 (0.047)
Meal Planner Education (wrt Elementary Education)													
HISC_ED	0.023 (0.003)	0.051 (0.004)	-0.026 (0.006)	0.029 (0.006)	0.065 (0.009)	0.021 (0.005)	-0.017 (0.003)	0.007 (0.003)	0.037 (0.003)	-0.002 (0.003)	-0.015 (0.006)	0.020 (0.004)	0.155 (0.035)
COLL_ED	0.011 (0.005)	0.048 (0.006)	-0.118 (0.010)	-0.013 (0.010)	0.075 (0.014)	0.009 (0.009)	-0.026 (0.006)	-0.004 (0.005)	0.016 (0.005)	-0.021 (0.005)	-0.044 (0.011)	-0.009 (0.007)	0.229 (0.057)
NO_ED	-0.029 (0.006)	-0.063 (0.009)	-0.038 (0.013)	-0.057 (0.014)	-0.078 (0.024)	0.006 (0.009)	0.012 (0.006)	-0.008 (0.006)	-0.052 (0.007)	-0.034 (0.007)	-0.004 (0.014)	-0.032 (0.009)	-0.184 (0.114)
Life Cycle (wrt Middle-Aged Multiple Adults With Children)													
Y_NK	-0.101 (0.007)	-0.067 (0.008)	-0.116 (0.012)	-0.125 (0.013)	-0.087 (0.019)	-0.002 (0.011)	-0.041 (0.007)	-0.030 (0.006)	-0.062 (0.006)	-0.048 (0.006)	0.034 (0.015)	-0.035 (0.008)	0.733 (0.080)
YM_1ADWK	-0.017 (0.007)	-0.016 (0.008)	-0.168 (0.014)	-0.079 (0.014)	-0.065 (0.024)	-0.065 (0.012)	-0.030 (0.007)	-0.034 (0.007)	-0.022 (0.007)	-0.058 (0.007)	-0.191 (0.015)	-0.056 (0.009)	-0.031 (0.085)
Y_MADWK	0.018 (0.003)	-0.002 (0.004)	-0.075 (0.007)	-0.061 (0.007)	-0.050 (0.011)	-0.020 (0.006)	-0.014 (0.004)	-0.015 (0.003)	-0.016 (0.004)	-0.037 (0.004)	-0.022 (0.007)	-0.015 (0.004)	0.078 (0.040)
MA_1ADNK	-0.065 (0.007)	-0.043 (0.010)	-0.063 (0.015)	-0.070 (0.016)	0.050 (0.022)	0.001 (0.013)	-0.011 (0.008)	-0.022 (0.008)	-0.022 (0.008)	0.000 (0.008)	0.080 (0.020)	-0.023 (0.010)	0.525 (0.105)
MA_MADNK	-0.069 (0.004)	-0.020 (0.005)	-0.076 (0.007)	0.027 (0.007)	0.072 (0.011)	-0.025 (0.006)	-0.027 (0.004)	-0.019 (0.004)	0.003 (0.004)	-0.005 (0.004)	0.024 (0.008)	-0.022 (0.005)	0.127 (0.043)
S_NK	-0.038 (0.006)	-0.016 (0.006)	-0.089 (0.011)	0.033 (0.011)	0.126 (0.015)	-0.048 (0.008)	-0.020 (0.006)	-0.024 (0.005)	0.022 (0.006)	0.005 (0.005)	-0.008 (0.011)	-0.028 (0.007)	-0.435 (0.069)
S_WK	0.000 (0.007)	0.002 (0.009)	-0.031 (0.014)	-0.002 (0.014)	-0.003 (0.023)	-0.045 (0.012)	-0.006 (0.007)	-0.005 (0.006)	0.006 (0.007)	-0.004 (0.007)	-0.028 (0.014)	-0.013 (0.009)	-0.021 (0.092)

(Continued)

meal planners are classified as being more educated, the frequency of dairy products purchased, as well as, amounts purchased is greater. This result may be a reflection of the positive income effect and the correlation between education and income level.

Table 7. Tobit Parameter Estimates for Various Food Groups (continued)*

Variable	Milk	Other Dairy	Beef	Poultry	Fish	Other Meats	Flour	Pastas	Fruit	Veggies	Alcoh. Drinks	No-Alcoh Drinks	Meals Away
Region of Residence													
MA_2	0.022 (0.007)	-0.012 (0.008)	0.096 (0.013)	0.018 (0.012)	-0.027 (0.016)	0.010 (0.011)	0.019 (0.007)	-0.003 (0.006)	-0.006 (0.006)	-0.011 (0.006)	0.027 (0.014)	0.007 (0.008)	-0.098 (0.068)
PAM_1	0.006 (0.008)	-0.044 (0.008)	0.152 (0.014)	-0.050 (0.013)	-0.123 (0.018)	0.013 (0.012)	0.011 (0.008)	-0.018 (0.006)	0.006 (0.007)	-0.017 (0.007)	0.057 (0.015)	-0.051 (0.009)	-1.135 (0.077)
PAM_2	0.035 (0.007)	-0.042 (0.008)	0.137 (0.014)	-0.028 (0.013)	-0.107 (0.017)	0.004 (0.012)	0.029 (0.007)	-0.016 (0.006)	-0.010 (0.007)	-0.030 (0.007)	0.098 (0.014)	-0.053 (0.009)	-1.344 (0.075)
PAM_3	0.016 (0.007)	-0.026 (0.008)	0.117 (0.013)	-0.010 (0.012)	-0.042 (0.016)	0.027 (0.011)	0.031 (0.007)	0.003 (0.006)	-0.006 (0.007)	-0.014 (0.006)	0.047 (0.014)	-0.049 (0.008)	-1.423 (0.075)
NO_1	-0.029 (0.007)	-0.066 (0.008)	0.184 (0.013)	-0.045 (0.013)	-0.118 (0.017)	-0.009 (0.011)	0.050 (0.008)	-0.057 (0.007)	-0.017 (0.007)	-0.009 (0.007)	-0.007 (0.015)	0.002 (0.008)	-0.752 (0.072)
NO_2	-0.013 (0.007)	-0.060 (0.008)	0.250 (0.013)	-0.030 (0.013)	-0.178 (0.019)	0.005 (0.012)	0.032 (0.008)	-0.028 (0.007)	0.002 (0.007)	0.021 (0.007)	0.009 (0.015)	0.021 (0.009)	-1.760 (0.083)
NE_1	0.035 (0.007)	-0.080 (0.009)	0.118 (0.015)	-0.059 (0.014)	-0.245 (0.022)	-0.030 (0.012)	0.082 (0.008)	-0.035 (0.007)	-0.059 (0.007)	-0.024 (0.007)	0.052 (0.015)	-0.027 (0.009)	-1.116 (0.080)
NE_2	0.033 (0.007)	-0.095 (0.009)	0.184 (0.015)	-0.055 (0.014)	-0.264 (0.022)	-0.043 (0.013)	0.066 (0.008)	-0.023 (0.007)	-0.041 (0.007)	-0.001 (0.007)	0.069 (0.016)	-0.019 (0.009)	-1.590 (0.089)
CUYO	-0.017 (0.007)	-0.044 (0.008)	0.127 (0.013)	-0.024 (0.012)	-0.037 (0.016)	0.003 (0.011)	0.005 (0.007)	-0.036 (0.006)	-0.030 (0.007)	-0.031 (0.007)	0.017 (0.015)	-0.073 (0.008)	-1.341 (0.074)
PAT_1	-0.026 (0.006)	-0.044 (0.009)	0.100 (0.014)	-0.015 (0.014)	-0.149 (0.020)	0.051 (0.012)	0.047 (0.007)	-0.048 (0.007)	-0.044 (0.007)	-0.020 (0.007)	0.026 (0.016)	-0.067 (0.009)	-2.017 (0.098)
PAT_2	-0.023 (0.007)	-0.071 (0.008)	0.086 (0.014)	-0.032 (0.013)	-0.113 (0.018)	0.018 (0.011)	0.058 (0.007)	-0.051 (0.006)	-0.023 (0.007)	-0.015 (0.006)	0.037 (0.015)	-0.069 (0.009)	-1.532 (0.080)
Heteroscedastic Function Variables													
INCOME	1.334 (0.032)	2.714 (0.045)	2.963 (0.047)	0.986 (0.065)	0.961 (0.104)	2.239 (0.034)	1.443 (0.026)	2.711 (0.053)	2.317 (0.041)	2.619 (0.035)	2.770 (0.045)	3.481 (0.047)	1.994 (0.069)
1/HHSIZE	-0.506 (0.013)	-0.035 (0.012)	-0.284 (0.008)	-0.197 (0.013)	-0.436 (0.035)	-0.232 (0.011)	-0.310 (0.005)	-0.111 (0.013)	-0.210 (0.012)	-0.164 (0.005)	0.261 (0.019)	-0.188 (0.013)	0.195 (0.027)
SIGMA	0.191 (0.001)	0.174 (0.001)	0.309 (0.002)	0.316 (0.004)	0.381 (0.007)	0.249 (0.001)	0.168 (0.001)	0.139 (0.001)	0.166 (0.001)	0.156 (0.001)	0.237 (0.002)	0.193 (0.002)	1.120 (0.016)

Note: Shaded area identifies statistically significant coefficients at 95% level. Standard errors are in parentheses. The omitted dummy variables used as a basis of comparison are households where the meal planner has less than a high school education, is classified as belonging to a MA_MAWK type of household and residing in sub-region Federal District of Buenos Aires. Except for HH_SIZE and TOT_INC, the sign of the estimated parameters indicates the sign of the marginal impact on both the probability of purchasing and conditional purchases.

When interpreting the impacts of household life-cycle stage on dairy product expenditures, remember that these impacts are measured relative to expenditure patterns for households whose meal planner is classified as middle-aged, where multiple adults are present, and where children are present. As such, for "Milk," we would hypothesize negative coefficients for other household life-cycle types that is, other household types would purchase less "Milk." From the results shown in Table 7, this is in fact the case, with the exception of Y_MADWK[13] type households. The same general result was obtained for the "Other Dairy" category. For example, we find that households without children at home purchase less "Milk" and fewer "Other Dairy" than our base category, which includes children.

For both the dairy product categories, there is a significant regional variation in dairy product demand. The Federal District of Buenos Aires is used as the base of comparison and therefore omitted. When consumption of "Other Dairy" is compared to this district, households located in all other regions, except the suburbs of Buenos Aires, purchase less as shown by a statistically significant regional dummy variable coefficient. There is less of a consistent pattern with respect to fluid milk expenditures.

Recognizing the heteroscedastic error structure, we see that the marginal impact of a change in HH_SIZE[14] is positive.[15] Similarly, we find positive income effects on dairy product purchases in both the direct model income coefficient and in the heteroscedastic function. We will evaluate these impacts using the elasticity measures outlined in Appendix B.

Summary of Other Food Expenditure Results

With the dependent variables being defined as the total amount spent on food by all household members, it is not surprising that for a majority of the food commodities analyzed we find quantity purchased is positively related to household size. For all food categories, except "Alcoholic Beverages," the inverse of household size negatively affects the variance of the error term. This implies that there is more variability in the error variance in larger size households. However, for the case of "Alcoholic Beverages," the variability of the error term decreases as the number of individuals living in the house increases.

For most food categories, we obtained significant negative FT_RATIO[16] coefficients, again implying lower purchase quantities and probability of food purchases for at-home consumption. The positive relationships between the FT_RATIO and "Meals Away From Home" (MAFH) and "Alcoholic Beverages" purchases indicate that as the number of working adults at home increases relative to the total number of adults, both the probability of purchasing these two goods and the conditional purchases will increase.

[13] Young multiple adults with children.

[14] Household size.

[15] Remember we use the inverse of household size (HH_SIZE) in the estimated econometric models. We use the inverse instead of household size to facilitate the estimation process. Thus a negative coefficient associated with the inverse of household size indicates a positive household size impact.

[16] The ratio of the number of adult members working outside the home to the total number of adults living in the household.

With respect to the impact of education, patterns similar to those obtained for dairy products were found for "Pasta," "Poultry," Fish and Shellfish," "Other Meats," "Fruits," "Non-Alcoholic Beverages," and "MAFH."

Using the household type MA_MADWK[17] as the basis of comparison, young households without children tend to purchase less "Beef" and "Poultry." However, this group purchases more "Alcoholic Beverages" and "Meals Away From Home" than our base category. However, middle-aged households without children (MA_MADNK and MA_1ADNK) tend to purchase more "Fish and Shellfish" and "MAFH."

Degree of urbanization has little impact among the most urbanized areas, but there are some regional differences in food expenditure patterns. The suburban area of Buenos Aires presents few differences with respect to expenditures in the Federal District. However, households in all regions spend more on beef and less on poultry and dairy products relative to the Federal District. We also observed some regional differences in Argentine milk purchases with respect to the Federal District of Buenos Aires.

Estimation of Income Elasticities

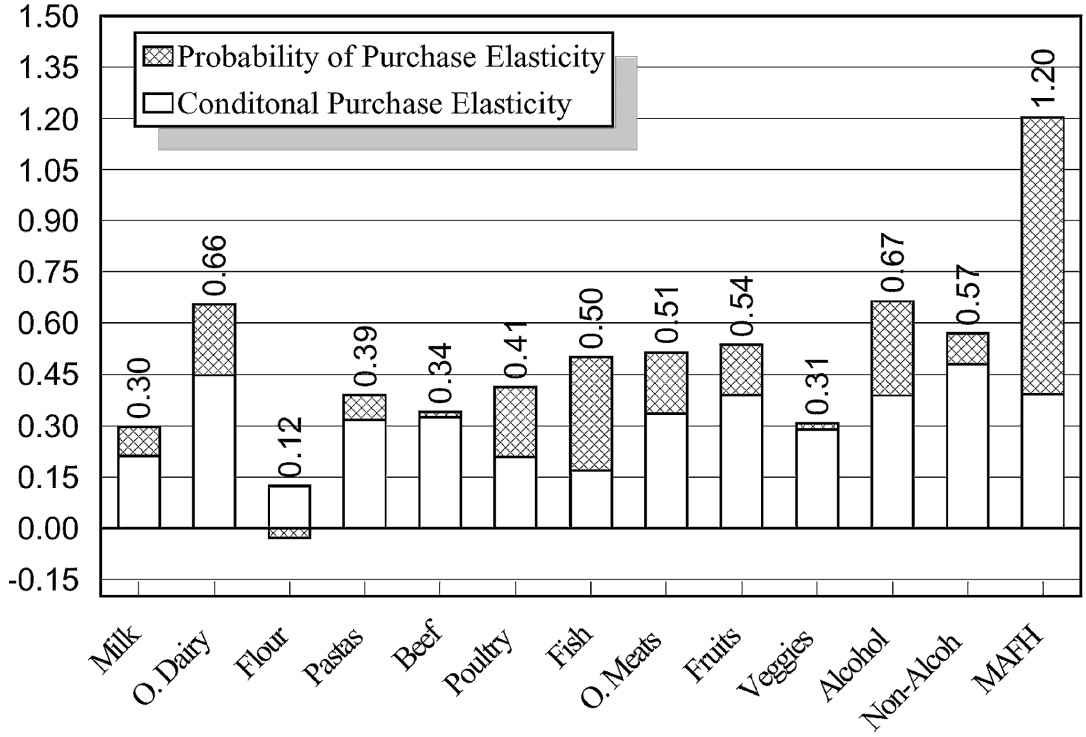
Given equations B.3 and B.4, and in contrast to the use of ordinary least squares, the use of the Tobit model implies that the marginal impact of a change in an explanatory variable on quantity purchased is not simply the estimated coefficient. To examine the impact of income on food purchase characteristics, Figure 1 displays the income elasticities obtained from the above Tobit models using the decomposition of total effects into market entry (probability Γ_{Φ}) and demand impacts ($\Gamma_{Y|Y^*>0}$) suggested by McDonald and Moffitt (equations B.8 to B.13). All the conditional, probability and total income elasticities shown in Figure 1 were found to be statistically significant at the 0.01 level. The relative size of the two sections of each bar shows the relative importance of the market entry versus conditional purchase impacts of change in income.

In terms of the two dairy product categories, we see that when evaluated at the mean values of the explanatory variables, a change in income results in more of a response from current versus new market entrants. That is, a majority of the response originates from current purchasers (e.g., conditional expenditures) with $\Gamma_{Y|Y^*>0}$ accounting for 64.7% and 71.3% for the "Milk" and the "Other Dairy" categories, respectively. The total income elasticities for these products are much less than 1 at 0.30 and 0.66, implying that dairy product demand increases less proportionally than the income increase.

The income elasticity of "Meals Away From Home" (MAFH) was found to have the relatively high Γ_{Φ} value of 0.81 with a total elasticity of 1.20. This implies that a percentage increase in income results in a more relative response in the probability of a household purchasing food for "MAFH" consumption versus the amount purchased if a purchase was to occur. This is in stark contrast to "Beef" purchases where the probability change or market entry impact is relatively low. This is obviously the result of the current high frequency of purchase.

[17] Young multiple adults with children.

Figure 1. Comparison of Estimated Probability of Purchase, Conditional Purchase, and Total Elasticities



Note: Total elasticities are the values displayed above each bar and equal the sum of the probability and conditional purchase elasticities.

Because income is hypothesized to impact error variance via the heteroscedastic function, the signs of the marginal impact of an income change on the market entry and conditional demand could differ. The only commodity where this actually happens is "Flour." For "Flour" expenditures, as income increases the probability of entering the market decreases, but this value is offset by a much larger conditional expenditure impact. All food products displayed in Figure 1 except "MAFH" can be considered necessities given that their total income elasticities are bounded between zero and one. Our results suggest that "MAFH" may be considered a luxury good since its total income elasticity was estimated to be significantly greater than 1.0.

VI. Implications of Results for Potential U.S. Dairy Exporters

Currently, Argentina does not represent a significant market for U.S. dairy exports. Why should the dairy industry be concerned with the role dairy products play in the typical Argentine diet. First, trade barriers between nations have decreased dramatically since 1947; for example, the average tariff on industrial goods has declined from about 40% to less than four percent (Maggi, 1999). The prospect is for a continuation in the evolution towards a free trade environment. This implies that past levels of export may not be indicative of future export patterns.

Would it be worthwhile for U.S. dairy exporters to look to South America as a potential market? Argentina is presently enrolled in a preferential trade agreement—MERCOSUR[18]—with the South American countries of Brazil, Uruguay, and Paraguay. Even as world tariffs are decreasing, previous international trade research has shown that countries with free-trade agreements have a tendency to reduce external tariff schedules to an extent that imports from countries outside the preferential trade agreement can increase (Ornelas 2000; Bagwell and Staiger, 1997). This implies that under MERCOSUR there is the potential for a reduction in Argentina's tariffs, hence reinforcing its trade with U.S. and the rest of the world.

Finally, U.S. dairy exporters will find information concerning the structure of Argentine dairy product demand useful given that the U.S. has started negotiations toward an "Americas Trade Agreement" that will include not only members of NAFTA[19] and MERCOSUR, but also all of Central and remaining South American countries.

The present analysis makes available to policymakers, potential exporters and other dairy industry participants' characteristics of how Argentine consumers allocate food expenditures between dairy and non-dairy products. Such information is important given the possibility of increased trade liberalization. Recent economic stabilization measures and market reforms resulted in substantial improvement in the Argentine economy in the 1990's.

Compared to other South American economies, Argentina posted the second fastest GDP growth between 1990 to 1997. The Argentine economy was forecasted to experience a real GDP growth greater than six percent in 2000 but macroeconomic problems resulted in substantially lower growth. Our analysis suggests that there is a positive relationship between household income and dairy product demand. We estimate that a one percent increase in income will increase fluid milk expenditures by 0.30% and "Other Dairy" expenditures by 0.66%. This income elasticity is the highest for the commodities analyzed with the exception of "MAFH" expenditures—even higher than "Beef," "Fish," and "Other Meats."

For a potential dairy exporter it is important to understand where increased dairy product demand originates: current consumers (e.g., intensive response) versus new market entrants (e.g., extensive response). The source of demand, in terms of the allocation of limited food budgets has different implications in terms of long-term growth potential and the types of promotional efforts. If, for a particular commodity, relatively more of the demand response originates from new market entrants, a different type of promotion effort may be required than a commodity where current consumers are the major source of increased demand. That is, significant promotional effort may be required to stimulate current non-consumers to purchase a commodity.

For this analysis we look at the impact of changes in dairy product (and other food) expenditures on the intensive versus extensive responses. In the case of "Milk" and "Other Dairy," we conclude that there is more response from current consumers versus new market entrants. From Figure 1, we see that for "Milk," 71.3% of the total response to changes in income originates from current consumers purchasing more milk and 28.7% comes from new consumers. For "Other Dairy" a similar value of 68.3% of the income response originates from current consumers. This trend is in stark contrast to "Beef" expenditures. Given the frequency

[18] Southern Cone Common Market
[19] North Atlantic Free Trade Agreement

with which "Beef" is purchased, less than 5% of the total income effect on beef expenditures is accounted for by new market entrants. Alternatively, two-thirds of the impact of a change in "Fish" expenditures originates from new entrants. A potential dairy exporter looking into Argentina's market should understand that under current conditions, with increased GDP, current fluid milk consumers will account for a majority of the growth in dairy product expenditures. With continued GDP growth and improved income distribution, the question of whether there will be an increase in the relative importance of new market entrants remains.

As is the case with U.S. demand for fluid milk, consumers in Argentina view dairy products as necessities (e.g., income elasticities < 1.0). Although not directly investigated here, this suggests to potential U.S. dairy product exporters the potential for relatively inelastic response to changes in dairy product price. This may have important implications even with reduced import tariffs.

Also similar to U.S. dairy demand, Argentine dairy product purchases are positively related to the educational attainment of the meal planner. This suggests that it may be important for U.S. dairy exporters to focus on the nutritional benefits of increased dairy product consumption. In addition, the role of children in stimulating Argentine household dairy product demand follows that observed in the U.S. Again similar promotional strategies with respect to children and dairy product consumption may be successful in Argentina.

There is little in the analysis to suggest that Argentina will become an important market for U.S. dairy exports. However, given the relatively high income elasticity of demand for dairy products in Argentina, domestic demand for dairy products under certain scenarios could claim a larger percentage of Argentina's domestic dairy product production, lessening the quantities of Argentine dairy products available for export. If Argentina's real incomes continue to rise, there also may be possibilities for expanded U.S. exports of highly differentiated dairy products to that country.

The analysis and conclusions drawn in this paper have their limitations. First, it is limited to the analysis of the relationship between food expenditures and household income without taking in consideration the effect of prices (this is due to the lack of price information in this survey). We have recently obtained household level data with a more detailed dairy product disaggregation, amount purchased and expenditures. A future Babcock Institute Discussion Paper will examine the role of dairy product prices in determining dairy product demand.

REFERENCES

1. Bagwell, Kyle and Robert W Staiger, 1997. Reciprocity, Non-discrimination, and Preferential Agreements in the Multilateral Trading System. **National Bureau of Economic Research** (Cambridge, MA), Working Paper No. 5932, February.
2. Gould, B.W. and J. Kim, 1998. Characteristics of Canadian and Mexican Dairy Product Purchases: A Comparison Using Household Expenditure Data, **Babcock Institute Discussion Paper**, 98-2, University of Wisconsin-Madison.
3. Gould, B.W. and H.C. Lin, 1994. *The Demand for Cheese in the U.S.: The Role of Household Composition*, **Agribusiness**, Vol.10(1):43-59, February.
4. Greene, William H, 1993. **Econometric Analysis**, Ed. 3. Prentice-Hall, Inc. Eds. New York. pp. 949-972.
5. Instituto Nacional de Estadística y Censos, 1998. Encuesta Nacional de Gasto de los Hogares 1996/1997. Total del País. Resultados Definitivos, Buenos Aires, Argentina.
6. Kim, J., and B.W. Gould, 1998. *The Structure of Meat, Poultry and Dairy Product Demand in the Former Soviet Union*, **Babcock Institute Discussion Paper**, 98-3, University of Wisconsin-Madison.
7. Maddala, G., 1983. **Limited Dependent and Qualitative Variables in Econometrics**, New York: Cambridge University Press.
8. Maggi, Giovanni, 1999. The Role of Multilateral Institutions in International Trade Cooperation, **American Economic Review**, Vol. 89(1):190-214, March.
9. McDonald, J. and R. Moffitt, 1980. *The Uses of Tobit Analysis*, **Review of Economics and Statistics**, 62:318-321.
10. Ornelas, Emanuel, 2000. Free Trade Areas With Politically Active Oligopolies. Paper presented at the **Econometric Society World Meeting** July 2000, Seattle.

Appendix A: Detailed Description of Expenditure Subgroups

Table A.1. Food Groupings*

Commodity Code	Product Description
11100	**Bakery Products:** Fresh and processed bread. Other bakery products, i.e. cookies, cakes, etc.
11200	**Flours, rice and cereals:** All kind and varieties of flours; all kind of rice and cereals (grain, sponged, prepared)
11300	**Fresh and dried pastas:** Fresh and dried spaghettis; processed/frozen pastas
12100	**Ofals:** Beef, pork and lamb ofals, i.e. liver, tongue, stomach, other.
12200	**Beef meat:** Fresh or frozen beef meat, semi-prepared food based on beef meat.
12300	**Pork meat:** Fresh pork meat.
12400	**Lamb meat:** Fresh lamb meat
12500	**Birds**: Fresh chicken and other kind of birds, semi-prepared food based on chicken.
12600	**Fresh or frozen fish:** Fresh or frozen fish, either from sea or river, semi-prepared food based on fish
12700	**Fresh or frozen shellfish:** Fresh or frozen shellfish, semi-prepared food based on shellfish. For shellfish: octopus, shrimps, lobster, etc.
12800	**Other fresh meat**: Rabbit, hare, boar, etc.
12900	**Preserved of frozen meats, hams, and pate**: Preserved food based on beef, pork or lamb, i.e. pate; hams; preserved food based on fish and shellfish
13100	**Oils** : Sunflower based oil, maize oil, grape oil, olive oil, etc.
13200	**Solids oils or fats:** Margarine and other solid fats from vegetal origin; solid fats from animal origin exclude milk based fat.
14100	**Milk:** Whole, semi-skim and skim milk, pasteurized and sterilized (UAT), powder and prepared milk.
14200	**Dairy products:** Milk derivatives: yogurt, milk based fat, cream, cheese, caramel, desserts, etc.
14300	**Eggs**: Chicken and other birds eggs.
15100	**Fresh, dried, preserved or frozen fruits:** Fresh or frozen fruits, dried fruits, preserved fruits, and fruits in syrup**.**
15200	**Fresh, dried, preserved or frozen green vegetables and roots:** Fresh, frozen and preserved green vegetables; semi-prepared food based on green vegetables.
15300	**Fresh, dried, preserved or frozen vegetables:** Fresh, frozen, dried, and preserved vegetables
16100	**Sugar, sweets and honey:** All kind of sugar (white, black, etc.); sweets, marmalades and jams, dietetics and other related products.
16200	**Cacao and chocolates:** Powder cacao, chocolate in all presentations.
16300	**Sweets and pastries:** Candies, sweets covered with chocolate, bubble gums, and pastry products.
17100	**Coffee, tea and other hot beverages:** Coffee, tea, herbal teas, other hot beverages

Table A.1. Food Groupings (continued)

17200	**Herbs and spices, condiments:** Salt, spices, condiments, vinegar, salsas
17300	**Processed food (food ready to be consumed):** Processed food based on meats, vegetables and roots; empanadas; ice-cream; pizza; etc; Baby processed food
17400	**Other groceries:** Soups, baking powder; yeast; ice-cubs
18100	**Alcoholic Beverages:** Alcohol beverages; wines; liquors; beer; sparkling wine.
18200	**Non-alcoholic beverages:** Mineral water and bottled water; juices; sodas, etc.
19100	**Meals and drinks in bars/restaurants during recreational time**: Meals and drinks during recreational or free time, i.e. weekends.
19200	**Meals and drinks in bars/restaurants for other reasons:** Meals and drinks due to study, work meetings, etc.

*Source: 1996/97 ENGH

Table A.2. Food Groupings Used in Tables 2 and 5*

Product Description	Commodity Codes
Milk	14100
Other Dairy Products	14200
Poultry	12500
Fish and Shellfish	12600, 12700
Beef, Pork and Lamb	12100, 12200, 12300, 12400, 12800
Flour, Rice and Cereals / Pastas	11200, 11300
Fruit	15100
Vegetables	15200, 15300
Alcoholic Beverages	18100
Non-Alcoholic Beverages	18200
Meals Away From Home (MAFH)	19100, 19200
Other Food	11100, 12900, 13100, 13200, 14300, 16100, 16200, 16300, 17100, 17200, 17300, 17400.

*Source: 1996/97 ENGH

Table A.3. Food Groupings Used in Model Estimation*

Product Description	Commodity Codes
Milk	14100
Other Dairy Products	14200
Beef	12200
Poultry	12500
Fish and Shellfish	12600, 12700
Other Meats	12100, 12300, 12400, 12800, 12900
Flour, Rice and Cereals	11200
Pastas	11300
Fruit	15100
Vegetables	15200, 15300
Alcoholic Beverages	18100
Non-Alcoholic Beverages	17100, 18200
Meals Away From Home (MAFH)	19100, 19200

*Source: 1996/97 ENGH

Appendix B: Description of the Econometric Model of Food Expenditures

The underlying econometric model of food expenditures used in this analysis can be expressed by the relationship between the unconditional purchases, Y, and a latent variable, Y*, which is observed only when expenditures are positive. The relationship between observed and latent expenditures can be represented by the following equation:

$$(B.1)\quad Y = \begin{cases} Y^* \ if \ Y^* > 0 \\ 0, \ \text{otherwise} \end{cases}$$

The specification in equation B.1 is commonly referred to as the Tobit model. Under this specification, latent consumption is related to a set of household characteristic (X) via the following equation:

$$(B.2)\quad Y^* = X\beta + e$$

Where $e_i \sim N(0,\sigma^2)$ and β is a vector of estimated coefficients. The expected value of the unconditional purchases under this framework is,

$(B.3)\quad E(Y) = X\beta\,\Phi(Z) + \sigma\,\phi(Z)$ Where $Z = X\beta / \sigma$, $\phi(Z)$ is the unit normal density function, and $\Phi(Z)$ is the cumulative standard normal distribution function. The expected value of purchases conditional on having positive expenditure patterns (Y > 0) under the Tobit model is,

$$(B.4)\quad E(Y \mid Y^* > 0) = E(Y \mid e > -X\beta) = X\beta + \sigma\frac{\phi(Z)}{\Phi(Z)}$$

The relationship between expected value of purchases across all observations and the expected value of conditional purchases is

$(B.5)\quad E(Y) = \Phi(Z)\,E(Y \mid Y^* > 0)$ The parameters of the Tobit model can be obtained from the following log-likelihood function:

$$(B.6)\quad \ln L = \sum_{y_i=0} \ln\left(1 - \Phi\left(\frac{X\beta}{\sigma_i}\right)\right) + \sum_{y_i>0}\left(-\ln\sigma_i + \ln\left(\phi\left(\frac{(Y_i - X\beta)}{\sigma_i}\right)\right)\right)$$

We test for the presence of error term heterogeneity by specifying the following variance function:

$$(B.7)\quad \sigma_i = \sigma\, e^{(S_i\xi)} \quad (i = 1,\ldots,N)$$

where σ is the homoscedastic variance, ξ a vector of estimated coefficients, N the number of households and S a matrix of variables hypothesized to impact error variance. In this application, we assume this matrix is composed of the variables TOT_INC[20] and the inverse of HH_SIZE[21].

McDonald and Moffitt (1980) show that,for the case of homoscedastic Tobit model, the relationship in equation B.5 can be used to decompose total unconditional expenditures by considering the change in the k^{th} exogenous variable on expenditures Y:

$$(B.8) \quad \frac{\partial E(Y)}{\partial X_k} = \Phi(z)\left(\frac{\partial E\left(Y \mid Y^* > 0\right)}{\partial X_k}\right) + E\left(Y \mid Y^* > 0\right)\left(\frac{\partial \Phi(z)}{\partial X_k}\right)$$

Thus the total change in the unconditional expenditure is disaggregated into the change in the conditional expenditures weighted by the probability of purchasing and the change in the probability of purchasing weighted by the conditional expenditures.

The change in the conditional expenditure in the homoscedastic case, using equation B.4 will be:

$$(B.9) \quad \frac{\partial E\left(Y \mid Y^* > 0\right)}{\partial X_k} = \beta_k\left[1 - Z\frac{\phi(Z)}{\Phi(Z)} - \frac{\phi(Z)^2}{\Phi(Z)^2}\right]$$

The change in purchase probability under the homoscedastic error structure is:

$$(B.10) \quad \frac{\partial \Phi(Z)}{\partial X_k} = \phi(Z)\frac{\beta_k}{\sigma}$$

In order to obtain unconditional income elasticity, we can multiply equation B.8 by X_k and divide by E(Y). After some simplification and using the relationship in equation B.5, the unconditional income elasticity can be shown to be:

$$(B.11) \quad \frac{\partial E(Y)}{\partial X_k}\frac{X_k}{E(Y)} = \frac{\partial E\left(Y \mid Y^* > 0\right)}{\partial X_k}\frac{X_k}{E\left(Y \mid Y^* > 0\right)} + \frac{\partial \Phi(Z)}{\partial X_k}\frac{X_k}{\Phi(Z)}$$

Thus the unconditional income elasticity (Γ_Y) equals the sum of the conditional income elasticity ($\Gamma_{Y|Y^*>0}$) plus the probability income elasticity (Γ_Φ).

The McDonald and Moffitt decomposition can be generalized to the case of the heteroscedastic Tobit model used in this analysis. When the exogenous variable impacts the dependent variable as well as the error variance, the impact of a change in this variable on expenditures must account for these direct and indirect effects. For the present analysis, this is the case for the income and household size variables. Let $z_j = X_j\beta/\sigma j$ with δ_j being defined by equation B.7 for the j^{th} household. The marginal impact on conditional expenditures of a change

[20] Household income
[21] Household size

in the k^{th} variable for the j^{th} observation can be represented by the following (using equation B.4):

$$\text{(B.12)}\quad \frac{\partial E\left(Y_j \mid Y_j^* > 0\right)}{\partial X_{k,j}} = \beta_k \left[1 - z_j \frac{\phi\left(Z_j\right)}{\Phi\left(Z_j\right)} - \frac{\phi\left(Z_j\right)^2}{\Phi\left(Z_j\right)^2}\right] + \xi_k \left[\frac{\phi\left(Z_j\right)}{\Phi\left(Z_j\right)}\left(X_j \beta Z_j + \sigma_j\right) + \frac{\phi\left(Z_j\right)^2}{\Phi\left(Z_j\right)^2}\left(X_j \beta\right)\right]$$

The first term in (B.12) is identical to the one obtained for the homoscedastic case. The second is the indirect effect of a change in the k^{th} exogoenous variable on error variance.

The change in the probability of purchasing, using the definition of Z_j in the heteroscedastic case will be:

$$\text{(B.13)}\quad \frac{\partial \Phi\left(Z_j\right)}{\partial X_{k,j}} = \phi\left(Z_j\right)\left[\frac{\beta_k}{\sigma_j} - \xi_k Z_j\right]$$

The unconditional, conditional and probability elasticities continue to be given in equation B.11.